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Host Risk Factors for Typhoid Fever in Children (A Case Study of North Sumatera Province)

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Background: Children aged 2–14 years old were susceptible to typhoid fever. Children usually have activities with their peers outside their houses. These activities could influence their eating behavior and personal hygiene. This study aimed to explain host factors that are the risk factors for typhoid fever in children. **Method:** A case control design was applied in this study. Ninety children were included, 45 cases and 45 controls. The cases were typhoid fever patients with TF Tubex ≥ 5 . Controls were non typhoid fever with TF Tubex ≤ 2 . Samples were collected by a consecutive sampling technique. Multiple logistic regression was applied in the analysis. **Results:** Results of multivariate analysis showed that the host factors proven to be the risk factors for typhoid fever in children. There were poor hand washing practice before eating (OR = 4.295; 95% CI = 1,232–14,969), poor food processing (OR = 4.658; 95% CI = 1.507–14.397), poor in using food cover (OR = 4.337; 95% CI = 1.475–12.749) and having typhoid fever history in the family (OR = 5.768; 95% CI = 1.037–32.093). Probability of typhoid fever occurrence in children aged 2–14 years if all of those risk factors existed was 99.5%. **Conclusion:** The host factors had important roles in the transmission of typhoid fever in children. Local health officers had responsible to conduct health promotion in the community to prevent typhoid fever in children.

Keywords: Host Factors, Typhoid Fever, Children.

1. INTRODUCTION

Typhoid fever is an acute infection caused by *Salmonella enterica* serovar *typhi* (*Salmonella typhi*) bacteria.^{1–4} Children at the age group of 2–14 are among those having the highest risk of the fever because they were capable of eating by themselves and consuming adult foods, doing activities outdoor and beginning to cope with their peers. Such conditions change their diet and personal hygiene behaviors.⁵ Several risk factors of the typhoid fever incidence in children have always been correlated to host factors and environmental conditions and vice versa. However the role of this host remarkably dominates the process of the disease development as well as its control. The host plays an important role as a biological creature. Therefore, it has two conditions that lead to the development of particular disease, namely the possibility of exposure and the possibility of resistance. They also determine the environmental quality with different treatments.⁶

According to the Center for Health Funding and Security (P2JK), typhoid fever is the second of ten most frequent cases that are suffered by inpatients.⁷ The number of the 6 to 14-years-old and 1 to 4-years-old patients are 6,854 and 9,747,

respectively.^{7,8} Basic health research reports that the typhoid fever has been ranked second (13%) as the cause of the death of the 5 to 14-years-old children in urban area.⁹ In 2015, there were 267 of 15,057 cases found in the inpatients (1.77%), with the total number of the 2 to 14-years-old patients were 92 (34.4%) at Martha Friska General Hospital Medan.¹⁰ At Mitra Medika General Hospital Medan, these figures were ranked the fifth of the most frequent diseases suffered by 183 of total 4,053 (4.5%) inpatient cases, among those 62 patients (33.8%) were from the 2 to 14 age group.¹¹

The government has already stipulated policy, strategy, and applied controlling system for typhoid fever through preventive, promotive, and curative efforts as well as strengthening the surveillance system and management control. These efforts are performed by partnership, network, cross-program, and cross-sector. Nevertheless, morbidity rate continues to rise, especially suffered by children. The incidence of the typhoid fever has been previously suspected due to the host factor. Therefore, there is an urgent need for a research to find out and to prove the host risk factors of the typhoid fever occurrence in order to monitor the development of the cases as well as to comprehend the prevention.

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2. METHOD

This study applied an observational analytic technique with case control design. It was aimed to evaluate the correlation between the exposure and the disease by determining case group and control group. The following step was comparing exposure frequency or level in both groups to discover which risk factors that differentiated the case group from the control group related to the typhoid fever in children. The population of the study was children of 2–14 years old group who had already been given a Tubex treatment and/or hospitalized at Martha Friska General Hospital and Mitra Medika General Hospital in Medan.

The observation was held from January 2015 to May 2016. The study only included the population who met the inclusion and exclusion criteria. Inclusion criteria of cases are typhoid fever patients aged 2 to 14 years with a Tubex value more than 5 who had been hospitalized or being treated in hospital in January 2015 to May 2016, children accompanied by their mother and stay in Medan City. Inclusion criteria for controls are observation of patients with febrile aged 2 to 14 years with a Tubex value less than 2 who had been hospitalized or being treated in hospital in January 2015 to May 2016, children accompanied by their mother and stay in Medan City. Exclusion criteria are not willing to be interviewed. Samples were collected by non probability sampling technique with a consecutive sampling method because the sampling of case and control group samples sequences based on secondary data from medical records. The minimum samples utilized were 45 case subjects and 45 control subjects.

The dependent variable of this study was typhoid fever incidence in 2 to 14-years-old children. Whereas the dependent variables consisted of hand wash behavior after defecation, ice cube consumption, meal cover use, typhoid fever history of the family members, well-done food processing for consumption, drinking water processing, recycle bin availability, household toilet facility, and maternal education. The study performed a bivariate analysis using a chi square statistic test and a multivariate analysis using a logistic regression.

Ethical clearance of this study had been obtained from the Ethical Commission of Health Research (KEPK) of the Faculty of Medicine, the Diponegoro University and National General Hospital Doctor Kariadi Semarang.

3. RESULTS

Bivariate analysis was used to determine the relationship between independent variables and the typhoid fever occurrence in the children as the dependent variable with the significance rate of 95%. The variables became candidates in the logistic regression analysis consisted of those having $p < 0.25$ in the result of bivariate analysis, i.e., hand washing behavior after defecation ($p = 0.140$), hand washing before eating ($p = 0.058$), ice cube consumption behavior ($p = 0.017$), improper meal cover use ($p = 0.002$), typhoid fever history of family members ($p = 0.063$), food processing for consumption ($p = 0.001$), drinking water processing ($p = 0.03$), garbage dump availability ($p = 0.013$), household toilet facility ($p = 0.024$), and maternal education ($p = 0.003$).

4. DISCUSSION

The logistic regression analysis demonstrated that the host factors became the risk factors of the typhoid fever incidence in the

Table I. Logistic regression test analysis results.

Risk Factor	B value	OR	95% CI	p
Poor hand washing behavior before eating	1.457	4.29	1.23–14.96	0.022
Poor well-done food processing for consumption	1.539	4.65	1.50–14.39	0.008
Improper meal cover use	1.467	4.33	1.47–12.74	0.008
Typhoid fever history of family members	1.752	5.76	1.03–32.09	0.045
Constant	-1.031			

children. They were poor hand washing behavior before eating, improper meal cover use, and typhoid fever history of the family members. The poor hand washing behavior before eating had the OR = 4.295 (95% CI = 1.232–14.969). It means the children group with poor hand washing behavior before eating had a risk of 4.295 times for suffering from typhoid fever compared to those with good hand washing behavior before eating.

This study agreed with the previous study conducted by Suprpto¹² which concluded that hand washing before eating have a risk of typhoid fever (OR = 3.4; CI (95%) = 1.4–8.5).¹² However, this study have different result from another study that carried out by Hosoglu et al. (2005), in which obtained a statistically non-significant correlation with p -value = 0.456 ($p > 0.05$) and OR = 1.42 (CI 95%: OR = 0.56–3.58) of the hand washing behavior before eating.¹³

The practiced of hand washing behavior before eating was frequently underestimated in daily life. Most families consumed meals using bare hands. They washed their hands with water in a container before eating. The water used collectively by the whole family members, causing the high risk of *Salmonella typhi* exposure. The reluctance of the family members, particularly to those aged 2 to 14 years old, to wash their hands with soap or flowing water was due to the fact that such action was deemed as wasting time and non-practical.

The poor well-done food processing for consumption correlated to the typhoid fever incidence in children ($p = 0.008$) and OR = 4.658 at 95% CI = 1.507–14.969. In other words, mothers who did poor well-done food processing before consumption had a risk of 4.658 times for causing the typhoid fever in the 2–14 years old children compared to those with good well-done food processing practice.

Cooking kills almost all hazardous microorganisms. The cooked food heating thoroughly helps assure that the food is safe for consumption. Such practice is the best protection from microbial attacks that potentially grow during the food storage.^{14,15}

Among the individuals with typhoid fever history, 1–4% may develop as chronically carriers (urine/feces cultures after three months) when they expose to the healthy individuals, giving 20-time risk of suffering from the typhoid fever.¹⁶ Under the multivariate analysis, the current study documented that the typhoid fever history of the family members had significant correlation to the typhoid fever incidence in the 2–14 years old children ($p = 0.045$) and became a risk factor of the typhoid fever incidence in the children (OR = 5.768) at 95% CI = 1.037–32.093. As concluded by Ayaz,¹⁷ the typhoid fever history in the family members is the risk factor of the typhoid fever incidence in <15 years old children.¹⁷

The field observation findings during interviews with several respondents documented that family members diagnosed with

typhoid fever generally preferred traditional medicines. They believed that the traditional medicines were capable of curing the disease completely. Therefore, they were potential of becoming simultaneous carriers and transmitting *Salmonella typhi* bacteria to the children.

The use of meal cover is one of food safety efforts. The food cover is important to protect the foods from contaminants. This practice is necessary in avoiding flies to reach the foods and preventing them from bad smell, which may invite flies to enter the house. The flies may initially land on feces or bacteria-contaminated water before reaching the uncovered foods. They eventually develop to reach a particular infective dosage.¹⁸ The improper use of the meal cover under the multivariate analysis showed a significant correlation to the typhoid fever incidence in the children ($p = 0.008$) with OR = 4.337 at 95% CI = 1.475–12.749. It means mothers who improperly covered the meals had a risk of 5.009 times to cause the typhoid fever in the 2–14 years old children compared to those with proper practice. The field observation findings proved that mother actually used the meal covers but the well-done foods were simply put on the stoves and improperly covered. Spoons were generally used for air ventilation and for preventing condensation of the foods. By doing so, they did not need to heat the already cooked foods.

Childhood began when they turn two years old and ended when they reached puberty (generally ± 14 years old). Pains in the childhood were affected by their behavior and attitude. Entering the second year of their lives, children began to experience a period where they exploit objects around them actively and imitatively.⁵ As they become older, turning 14, the children create a playgroup, spending much time outdoor. Such phenomena will lead to the change in behavior.¹⁹

A case in Kalkaji recorded that 44% of the *Salmonella typhi* infections occurred in 1 to 5 years old children.²⁰ In this study, ≤ 7 -year-old children became protective factor towards the incidence of the typhoid fever ($p < 0.05$, $p = 0.001$, OR: 0.101 95% CI = 0.026–0.387). In other words, the older the children (≥ 8 years old), the higher the risk of suffering from typhoid fever. The 1 to 7 years old children still have a special attention from their mothers and the rest of family members.

In general, 2 to 3 years old children were still breastfed three times a day at minimum with food variety quite similar to those consumed by adults albeit having a special treatment during the food processing. Similarly, the 3 to 7 years old children were also under restricted consumption manner. Although the children have begun to attend school, mothers still equipped them with home-made foods in order to assure the food hygiene. As the children getting older, the exploration is getting larger, therefore the risk of being exposed by the *Salmonella typhi* bacteria is getting higher. The study limitations were as follows: it was a retrospective (case control) design with possible recall bias; it focused on host behavior of the children when they spent their times outdoor without examining the host behavior outdoor; and missing analysis of other risk factors in the children (immunization status, disease history, nutrition status, and children behavior to buy foods), which were also discussed in theoretical

framework but not examined due to inadequacy of time and funding.

5. CONCLUSION

The study concluded that the proven variable to be the risk factor of the typhoid fever occurrence in the children was poor hand wash behavior before eating. In the mother side, the risk factors consisted of poor well-done food processing for consumption, improper use of meal cover, and typhoid fever history of the family members. The probability of causing the typhoid fever in children if these four risk factors were found was 99.5%. The study also proved that the variables that did not become the risk factors were poor hand wash behavior after defecation, raw water ice cube consumption, inadequate household toilet facility, unavailability of boiled water in the household, inadequate garbage dump, and poor maternal education level.

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